(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 309 656 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **25.03.92**

(51) Int. Cl.[5]: **C21D 9/00**, B21B 1/46

(21) Application number: **88110531.6**

(22) Date of filing: **01.07.88**

(54) **Roller hearth reheating furnace for continuously cast slabs.**

(30) Priority: **05.08.87 IT 8342787**

(43) Date of publication of application:
05.04.89 Bulletin 89/14

(45) Publication of the grant of the patent:
25.03.92 Bulletin 92/13

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(56) References cited:
EP-A- 0 264 459
FR-A- 1 559 355
FR-A- 2 498 092

IRON AND STEEL ENGINEER, vol. 44, no. 9, September 1967, pages 119-126, Pittsburg, PA, US; C. CONE: "Reheating furnaces for continuous steelmaking"

PATENT ABSTRACTS OF JAPAN, vol. 8, no. 207 (M-327)[1644], 21st September 1984, page 14 M 327; & JP-A-59 94 501 (KAWASAKI SEITETSU K.K.) 31-05-1984

(73) Proprietor: **DANIELI & C. OFFICINE MECCANICHE S.p.A.**
Via Nazionale, 19
I-33042 Buttrio (UD)(IT)

(72) Inventor: **Benedetti, Giampietro**
Villaggio Primavera Via degli Aceri 18
I-33030 Campoformido (UD)(IT)
Inventor: **Di Giusto, Bruno**
Viale G.B.Bassi 18/2
I-33100 Udine(IT)

(74) Representative: **Petraz, Gilberto Luigi**
GLP S.r.l. Piazzale Cavedalis 6/2
I-33100 Udine(IT)

Rank Xerox (UK) Business Services

PATENT ABSTRACTS OF JAPAN, vol. 8, no. 76 (M-288)[1513], 9th April 1984, page 54 M 288; & JP-A-58 221 602 (MITSUBISHI DENKI K.K.) 23-12-1983

PATENT ABSTRACTS OF JAPAN, vol. 7, no. 291 (M-265)[1436], 27th December 1983, page 36 M 265; & JP-A-58 163 505 (NIPPON KOKAN K.K.) 28-09-1983

STAHL UND EISEN, vol. 104, no. 22, 29th October 1984, pages 59-63, Düsseldorf, DE; H. WIESINGER et al.: "Brammenwarmeinsatz und Direktwalzung"

PATENT ABSTRACTS OF JAPAN, vol. 7, no. 9 (M-185)[1154], 14th January 1983, page 160 M 185; & JP-A-57 168 720 (SHIN NIPPON SEITETSU K.K.) 18-10-1982

Description

This invention concerns a plant to equalize the temperature of slabs downstream of a continuous casting machine in a continous plant for the rolling of coils. The invention concerns also a method which can be obtained with such a plate.

To be more exact, this invention concerns a plant to equalize the temperature of slabs downstream of a continuous casting process, such plant forming part of a continuous plant to roll strip.

The equalization plant is suitable also to meet requirements linked to obstacles in the rolling train and other auxiliary requirements and also requirements connected to the slowing down of output for any reason.

Temperature-equalization furnaces are known which entail a plurality of problems linked to the cold points which occur when a slab has to be halted momentarily before it can be sent forward for rolling.

This drawback of cold points is of greatest importance where it is necessary to roll slabs to obtain coils, namely continuous sheet, or strip of a small thickness, such strip possibly being also finally coiled in rolls.

It should be borne in mind that a slab halted in the equalization furnace has to remain therein at least for the time required for it to acquire a substantially constant temperature throughout its length and thickness.

This means that the equipment supporting the slab undergoes a considerable thermal stress, which is especially great when the support equipment consists of rollers.

The rollers which support the slabs in an equalization furnace are therefore cooled with water, but the points of contact between the rollers and the slab are precisely the cause of the cold points that give rise to unfavourable results in the subsequent rolling process and thereafter in the final result connected with the product itself.

Moreover, in a continuous processing line to produce strip starting from continuous casting there may be many reasons for halting production either in the continuous casting process or in the rolling train, accompanied by difficulties connected to the discharge of slabs coming from the casting line.

Such shortcomings become even more problematical when they occur in the rolling train since they hinder correct processing upstream.

The document "Iron and Steel, Vol. 44, No.9 of September 1967, pages 119-126" illustrates a temperature-equalization plant for slabs downstream of a continuous casting process in an in-line plant for continuous production of strip, statring from a continuous casting machine, the plant comprising a temperature-equalization furnace and an inlet shears and outlet shears at the inlet and outlet of the furnace, the equalization furnace being equipped with entry and exit doors and cooled rolls.

The document "Patent Abstracts of Japan, VoL.8, No.207 (M-327) (1644)" discloses a method for the continuous rolling of strip, starting from a continuous casting process, whereby in the event of an obstacle in the rolling train the part of a slab which has still not been rolled is cut by shears, returned by the equalization furnace and kept there until the obstacle has been eliminated.

The invention therefore concerns in particular the continuous plants for rolling slabs to produce continuous sheet and/or strip, which may be coiled also in rolls, starting from continuous casting.

To obviate the above shortcomings and make considerable flexibility possible in plants which roll continuously the slabs produced by continuous casting so as to obtain continuous sheet or strip, the present applicant has studied and embodied this invention.

According to the invention an equalization furnace having inlet and outlet doors which can be shut is provided with a shears at its inlet and a shears at its outlet.

A measurement system able to read the length of a slab entering the furnace is preferably provided in cooperation with the inlet of the equalization furnace.

This measurement system is enabled to actuate the inlet shears to carry out shearing when the length of the slab coincides with the value of the weight of the strip, or final roll of strip, which it is necessary to obtain.

According to the invention, after the slab has been sheared to size, it is accelerated within the equalization furnace by variable-speed driven rollers included in the furnace. This acceleration serves to distance the tail of the sheared slab from the head of the next slab.

The length of the equalization furnace is normally dimensioned in such a way that it can contain a slab sheared to size, plus a length corresponding to the time needed for the temperature of the slab to be made uniformly homogeneous plus an interspace which is determined between the head and tail of two consecutive slabs.

When the required equalization of the temperature of the slab has been reached, the slab is moved forwards quickly and brought up to a speed very close to that of the first rolling stand of the hot-rolling mill, which will convert it into strip and then possibly will coil it.

According to the invention normally a heater to heat the edges of the slab is located upstream of the first rolling stand.

When any obstacle occurs in the hot-rolling

mill and a part of a slab has still to be rolled while the other part is already between the rolling rolls, the invention works as follows.

The continuous casting machine is halted and the shears at the outlet of the furnace performs emergency shearing of the slab thus obstructed.

The segment of slab thus sheared while about to be rolled is returned to the furnace, whilst the segment of slab between the casting machine and the furnace is sheared and then introduced into the furnace.

The inlet and outlet doors at the ends of the furnace are shut so as to prevent loss of heat and oxidization of the two segments of slab in the furnace.

According to the invention, in such conditions the rollers of the furnace are caused to oscillate so as to avoid deformation of the rollers subjected to thermal stress.

The oscillation consists of a desired angular rotation in one direction, followed by a desired angular direction in the opposite direction, and has the further purpose of preventing the formation, in the slabs parked within the equalization furnace, of cold points which create problems later during rolling.

EP-A-264 459 (document of Art. 54 (3)) discloses a temperature equalization furnace following a continuous casting machine, while, according to the present invention, has to and fro rotatable transporting rollers but has no shear at its outlet.

According to the invention the rollers, which may be of an individually powered type, comprise replaceable wearing rings circumferentially, while they include lateral retention flanges advantageously.

When processing conditions have been restored and enable rolling to be re-started, the slabs kept in the furnace are rolled and provide underweight strip as compared to the strip which they should have provided, this being due to the fact that the strip has been produced with shorter slabs.

Instead, if for any reason the continuous casting machine has to continue producing, the invention provides a variant in which a discharge conveyor cooperating with a lateral traversing conveyor and with the inlet shears is positioned upstream of the equalization furnace.

In this case the slab coming from the continuous casting machine is sheared into segments of a desired length, for instance between two and three metres. These segments are traversed laterally and cooled until they reach a stacker, for example, so that they can be used thereafter in a conventional hot-rolling machine to produce sheet or other products.

The invention is therefore embodied with a plant for the temperature-equalization of slabs downstream of a continuous casting machine in a plant for the continuous production of strip, which may also be coiled in rolls, according to the content of Claim 1 and the claims dependent thereon.

The invention is also obtained with a method which can be brought about with such plant according to the content of Claim 5 and the claims dependent therein.

The attached figures, which are given as a non-restrictive example, show the following:-

- Fig.1 gives a plan view of a plant according to the invention;
- Fig.2 shows a preferred section of the equalization furnace;
- Fig.3 shows a segment of the lengthwise section of the furnace of Fig.1.

In the figures a temperature-equalization plant 10 is located downstream of a continuous casting machine 11 able to cast slabs 20 suitable to produce strip or strip coiled in rolls, the plant 10 cooperating with an inlet shears 12 and an equalization furnace 16.

The example given shows the equalization furnace 16 with the variant cited earlier, so that a lateral traversing conveyor 13 cooperating with a transfer conveyor 14 equipped at its end with a stacker 15 is included immediately downstream of the inlet shears 12.

A measurement system 25 is comprised in cooperation with the inlet shears 12 in a position upstream of the equalization furnace 16.

An outlet shears 17, downstream of which is positioned a rolling train 18 suitable to produce strip, is situated at the downstream end of the furnace 16.

A scaling machine 29 operating with a jet of fluid under pressure and a heater 30 to heat the edges of slabs 20 are located advantageously upstream of the rolling train 18. The heater 30 may comprise burners but is advantageously an induction heater.

The rolling plant shown in Fig.1 is an in-line plant suitable to perform continuous rolling, starting with continuous casting and producing hot-rolled strip at its end.

The equalization furnace 16 is equipped with upper burners 19 above the slab 20 and lower burners 24 below the slab 20, drive rollers 21 being included within the furnace 16 . In this example the drive rollers 21 are actuated by a motor 26 and cooled by circulation of water.

The cooled drive rollers 21 comprise replaceable wearing rings 23 circumferentially and replaceable retention flanges 22 laterally, the flanges being suitable to retain the slabs 20 laterally.

When the slab 20 coming from the continuous casting machine 11 begins to enter the furnace 16 at the casting speed, its length is read by a mea-

surement system 25 cooperating with a control and data-processing unit 27.

When there is a correct relationship between the length of the slab 20 and the weight of the strip to be finally rolled, the data-processing unit 27 actuates the inlet shears 12 and causes a clean shear between the slab being case and the segment of slab 20 already cast and possessing the required length.

When the slab 20 has been sheared to size, it is accelerated by the drive rollers 21, which receive an appropriate command from the data-processing unit 27. Such acceleration is needed to separate the sheared slab 20 from the slab being cast.

When the slab 20 within the furnace 16 has reached the required equalization of temperature, it is fed forwards swiftly at a speed very close to the speed of the first stand of the rolling train 18.

If any obstacle occurs in the rolling train 18 during rolling, the data-processing unit 27 actuates the outlet shears 17, which separates the segment of slab in the rolling train 18 from the segment still present in the equalization furnace 16.

The segment still in the furnace 16 is retracted therein and the inlet and outlet doors of the furnace 16 are shut.

If for any reason the continuous casting machine 11 has to continue working, the cast slab is sheared into segments, thus providing plates 28 which are discharged by the lateral traversing conveyor 13 onto the transfer conveyor 14 and cooled until they arrive, already cooled, at the stacker 15.

The plates 28 are then transferred from the stacker 15 to a plant which rolls them into sheet or other products, for instance.

In the meantime the slabs 20 in the equalization furnace 16 are provided with a to-and-fro oscillatory movement, whereby the cooled rollers 21 carry out substantially, for example, a complete revolution in one direction and then substantially a complete revolution in the other direction.

This movement has the effect that the slab 20 advances and retreats substantially by a length equal to the development of a complete revolution of the wearing rings 23 on which the slab 20 is supported.

This to-and-fro oscillatory movement has the result that, owing to the action of the upper and lower burners 19-24, the slab 20 does not develop cold points which would otherwise give rise to an unsuitable final product during processing.

Claims

1. Plant (10) for the temperature-equalization of slabs downstream of a continuous casting machine (11) in an in-line plant for the continuous production of strip, starting from the continuous casting machine (11), the temperature-equalization plant (10) comprising a temperature-equalization furnace (16) and an inlet shears (12) and outlet shears 917) positioned respectively at the inlet and outlet of the furnace (16), which is equipped with inlet and outlet doors and cooled rollers (21), the plant (10) being characterized in that the cooled rollers (21) are capable of oscillatory rotation.

2. Plant (10) as claimed in Claim 1, in which a heater (30) to heat the edges of the slabs is included downstream of the equalization furnace (16).

3. Plant (10) as claimed in Claim 1 or 2, in which an inlet measurement means (25) controlling the inlet shears (12) is comprised upstream of the equalization furnace (16).

4. Plant (10) as claimed in any claim hereinbefore, in which the cooled rollers (21) comprise replaceable retention flanges (22) laterally.

5. Method for the continuous rolling of strip, starting from continuous casting, whereby in the event of an obstacle in a rolling train (18) the part of a slab (20) not yet rolled is sheared by the outlet shears (17), returned to the equalization furnace (16) and kept there until the obstacle has been removed, the method being characterized in that such part of the slab (20) is kept in the equalization furnace (16) with a to-and-fro movement by means of an oscillatory rotation of cooled rollers (21).

6. Method as claimed in Claim 5, in which in the event of an obstacle in the rolling train (18) the slab (20) being cast which has passed the inlet shears (12) is sheared and sent into the equalization furnace (16), where it is kept with a lengthwise oscillatory movement while the continuous casting machine (11) is halted.

7. Method as claimed in Claim 5, in which in the event of an obstacle in the rolling train (18) the slab (20) being cast which has passed the inlet shears (12) is sheared and sent into the equalization furnace (16), where it is kept with a lengthwise oscillatory movement while the slab being formed by the continuous casting machine (11) is sheared into segments (28) which are discharged laterally.

Revendications

1. Installation (10) en vue de l'égalisation en tem-

pérature de brames en aval d'une machine de coulée continue (11) dans une installation en ligne de production en continu de feuillards, commençant par la machine à coulée continue (11), l'installation d'égalisation de température (10) comprenant un four (16) d'égalisation de température et un couteau d'entrée (12) et un couteau de sortie (17) placés respectivement à l'entrée et à la sortie du four 16, qui est équipé de portes d'entrée et de sortie et de rouleaux (21) refroidis, l'installation (10) étant caractérisée en ce que les rouleaux (21) refroidis sont capables d'une rotation oscillante.

2. Installation (10) selon la revendication 1, dans laquelle un réchauffeur (30) servant à réchauffer les bords des brames est compris en aval du four d'égalisation (16).

3. Installation (10) selon les revendications 1 ou 2, dans laquelle un moyen de mesure à l'entrée (25) commandant le couteau à l'entre (12) est situé en amont du four d'égalisation (16).

4. Installation (10) selon l'une quelconque des revendications ci-dessus, dans laquelle les rouleaux refroidis (21) comprennent des brides de retenue latérale remplaçables.

5. Procédé de laminage en continu de feuillards, commençant par une coulée continue, dans lequel lorsqu'apparaît un obstacle dans le train de laminage (18) la partie d'une brame (20) non encore laminée est découpée par les couteaux de sortie (17),est envoyée dans le four d'égalisation (16) et y est maintenue jusqu'à ce que l'obstacle ait été enlevé, le procédé étant caractérisé en ce qu'une telle partie de la brame (20) est maintenue dans le four d'égalisation (16) avec un mouvement d'avant en arrière, au moyen de la rotation oscillante de rouleaux (21) refroidis.

6. Procédé selon la revendication 5, dans lequel lorsqu'un obstacle apparaît dans le train de laminage (18), la brame (20) en cours de coulée qui a passé les couteaux d'entrée (12) est découpée et envoyée dans le four d'égalisation (16), où elle est maintenue avec un mouvement oscillant longitudinal pendant que la machine de coulée continue (11) est arrêtée.

7. Procédé selon la revendication 5, dans lequel lorsqu'apparaît un obstacle dans le train de laminage (18), la brame (20) en cours de coulée qui a passé devant les couteaux d'entrée (12) est découpée et envoyée dans le four d'égalisation (16), où elle est maintenue avec un mouvement oscillant longitudinal pendant que la brame en cours de formation par la machine de coulée continue (11) est découpée en segments (28) qui sont déchargés latéralement.

Patentansprüche

1. Anlage (10) zum Temperaturausgleich von Brammen stromab einer Stranggußmaschine (11) in einer Reihenanlage zur kontinuierlichen Herstellung von Bändern, wobei die Anlage (10) zum Temperaturausgleich, ausgehend von der Stranggußmaschine (11), einen Temperaturausgleichofen (16), eine Eingangsschere (12) und eine Ausgangsschere (17) aufweist, die an dem Eingang bzw. an dem Ausgang des Ofens (16) gelegen sind, welcher mit einem Eingangs- und einem Ausgangstor und mit gekühlten Rollen (21) versehen ist, und die Anlage (10) dadurch gekennzeichnet ist, daß die gekühlten Rollen (21) eine oszillierende Drehung ausführen können.

2. Anlage (10) nach Anspruch 1, bei welcher stromab des Ausgleichofens (16) ein Heizgerät (30) zum Erhitzen der Brammenkanten vorgesehen ist.

3. Anlage (10) nach Anspruch 1 oder 2, bei welcher stromauf des Ausgleichofens (16) eine die Einlaßschere (12) steuernde Eingangsmeßeinrichtung (25) vorgesehen ist.

4. Anlage (10) nach einem der vorgehenden Ansprüche, bei welcher die gekühlten Rollen (21) an ihren Seiten austauschbare Rückhalteflansche (22) besitzen.

5. Verfahren zum kontinuierlichen Walzen von Bändern, das von einem Strangguß ausgeht und bei welchem für den Fall, daß ein Hindernis in der Walzstraße (18) auftritt, jener Teil der Bramme (20), der nocht nicht gewalzt wurde, mittels der Ausgangsschere (17) abgeschnitten, zu dem Ausgleichofen (16) zurückgebracht und hier gehalten wird, bis das Hindernis entfernt ist, wobei das verfahren dadurch gekennzeichnet ist, daß ein solcher Teil der Bramme (20) unter einer hin- und hergehenden Bewegung in dem Ausgleichofen (16) gehalten wird, die auf einer oszillierenden Drehung der gekühlten Rollen (21) beruht.

6. Verfahren nach Anspruch 5, bei welchem für den Fall, daß ein Hindernis in der Walzstraße (18) auftritt, die gegossene Bramme (20), welche durch die Eingangsschere (12) gelaufen

ist, abgeschnitten und in den Ausgleichofen (16) gesandt wird, wo sie unter in Längsrichtung einer oszillierenden Bewegung gehalten wird, wogegen die Strangguβmaschine (11) angehalten wird.

7. Verfahren nach Anspruch 5, bei welchem für den Fall, daß ein Hindernis in der Walzstraße (18) auftritt, die gegossene Bramme (20), welche durch die Eingangsschere (12) gelaufen ist, abgeschnitten und in den Ausgleichofen (16) gesandt wird, wo sie unter einer in Längsrichtung erfolgenden oszillierenden Bewegung gehalten wird, wogegen die von der Strangguβmaschine (11) gebildete Bramme in Abschnitte (28) zerschnitten wird, die zur Seite hin abgeführt werden.

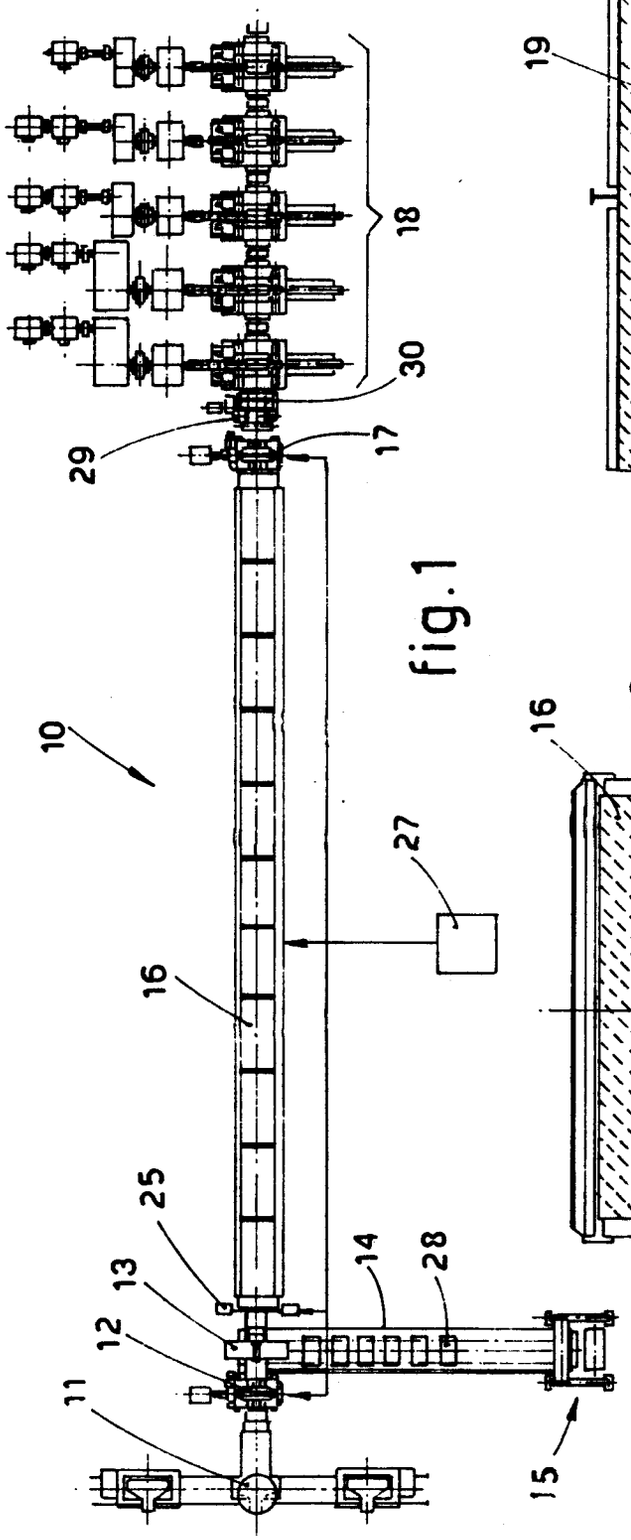

fig.1

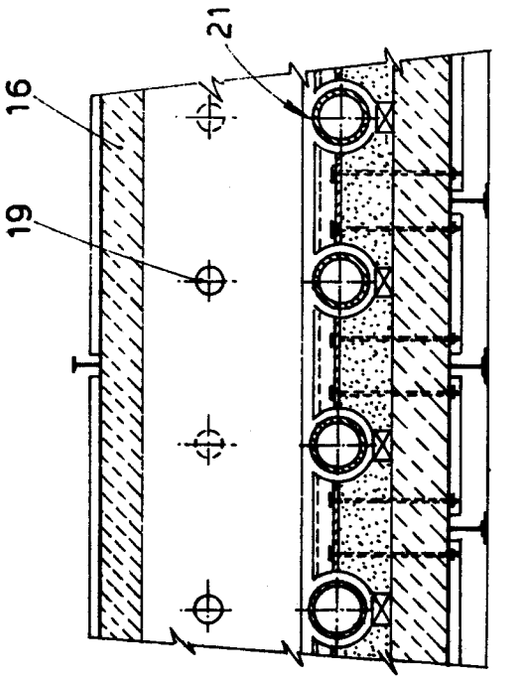

fig.3

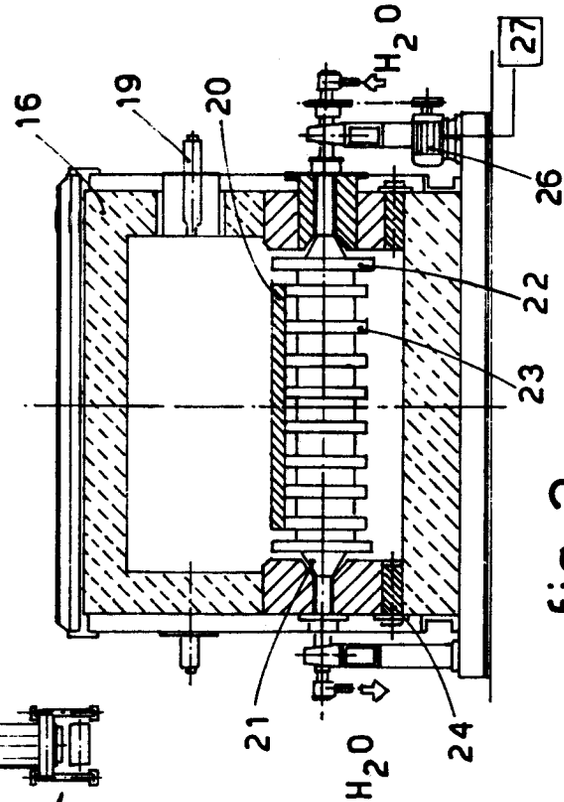

fig.2